IN THE SPECIFICATION:

Please amend paragraph **[0016]** as follows:

[0016] FIG. 1 is a perspective view of an exemplary prior art substrate showing ~~one-dimensional~~ one-dimensional warpage in a first direction;

Please amend paragraph **[0017]** as follows:

[0017] FIG. 2 is a perspective view of an exemplary prior art substrate showing ~~one-dimensional~~ one-dimensional warpage in a second direction;

Please amend paragraph **[0018]** as follows:

[0018] FIG. 3 is a perspective view of an exemplary prior art substrate showing ~~one-dimensional~~ one-dimensional warpage in a third direction;

Please amend paragraph **[0019]** as follows:

[0019] FIG. 4 is a perspective view of an exemplary prior art substrate showing ~~two-dimensional~~ one-dimensional warpage;

Please amend paragraph **[0031]** as follows:

[0031] In use and operation, and referring to FIGS. 1, 2, 3 and 4, an exemplary ~~pseudo-planar~~ pseudo-planar substrate 10 such as a memory module is depicted. The term "pseudo-planar" is used to denote a substrate which is substantially planar and, to the naked eye, may appear to be planar, but which in actuality may exhibit nonplanarity in the form of warpage. The substrate 10 is depicted as having two major surfaces which are generally rectangular in shape and may be subject to variations in thickness and/or warpage. The degree of warpage shown in the figures is generally exaggerated for illustrative purposes. The substrate 10 is shown with first and second major surfaces 20A and 20B, respectively, which have a nominal length 12, a nominal width 14 and nominal thickness 16 therebetween. The lateral edges of substrate 10 are designated as edges 18A, 18B and the end edges as 22A, 22B. Substrate 10 is pictured as having

been cut from a larger panel of substrate material (not shown) having internal stress(es) introduced during panel fabrication. The substrate 10 may have other structures mounted thereon, such as semiconductor devices and/or other components, not shown. As a result of the internal stress(es), warping in different directions may occur due to stress relief upon cutting of discrete substrates from the panel. As shown in FIG. 1, longitudinal warping along the X-axis results in warpage displacement 26A in the Z-direction transverse to the major plane of substrate 10, and is defined as displacement of substrate major surface 20A from a straight line 24A connecting the end edges 22A and 22B of the substrate 10. Line 24A represents the theoretical location of major surface 20A if the substrate 10 was truly planar. The term "warpage" may represent various dimensional attributes of substrate 10; for the purposes of this application, "warpage" represents the actual displacement from a straight line 24A representing a plane through the ends of a major surface, i.e., a condition of no warping, and will be generally indicated at a point of maximum displacement.

Please amend paragraph **[0035]** as follows:

[0035] In one embodiment of the invention, depicted in FIG. 5, the apparatus for determining the thickness 16 and one or more warpage displacements 26A-C (any displacement, simple or complex, being referred to herein by the numeral 26) of a pseudo-planar substrate 10 comprises a caliper gauge 40 having two yoke members 42A, 42B respectively mounted on bases 44A, 44B. Each yoke member 42A, 42B includes a linear measuring device 50A or 50B which is ~~actuable~~ actuatable by an axially movable caliper finger 60A or 60B having a contact member 52A, 52B at a free, distal end thereof. Linear measuring devices 50A, 50B may comprise commercially available linear displacement measurement devices, including without limitation linear encoders, linear potentiometers, and linear displacement transducers. Linear encoders may take distance readings optically and employ either a glass scale or take distance readings magnetically and use a magnetic scale. In optical encoders, a glass scale is marked with alternating black and clear marks and the encoder outputs a sine or square wave responsive to reading the alternating black and clear marks as the encoder head moves past them. In a

magnetic type encoder a magnetic scale with alternating N and S poles is employed, and the encoder outputs a sine or square wave as the encoder head moves past them. For the present application, the scales would be mounted to a solid base and the encoder heads would be mounted to the probe tips or caliper fingers 60A, 60B. The caliper fingers 60A, 60B are coaxial about a common axis 38, carry contact members 52A, 52B and are biased by springs or other resilient elements, magnetic force, etc., along axis 38 to move against opposing surfaces 20A and 20B, respectively, of substrate 10 disposed transversely therebetween, at which point their displaced linear distance positions are individually sensed by the two linear measuring devices 50A, 50B and recorded in memory 68 for computation by a calculating device in the form of computer 70. A carrier 32 holds and positions the substrate 10 at an attitude substantially normal to the contact members 52A, 52B between the yoke members 42A, 42B for making the measurements at specified corresponding locations 56A, 56B on the generally parallel surfaces 20A, 20B. The carrier 32 is movable by actuator 64 in a plane 62 normal to axis 38 so that multiple measurements may be readily performed at specific desired locations on a substrate 10 as it passes between contact members 52A, 52B in a direction perpendicular to the plane of the drawing sheet. For example, one measure of warpage may be obtained by recording measurements at as few as three locations on a substrate 10. Preferably, carrier 32 comprises a robotic gripper of an automated assembly line such as is found in the manufacture of semiconductor memory modules wherein semiconductor devices are placed on circuit boards, for example. In one embodiment, carrier 32 is configured to move substrate 10 continuously to produce a continuum or semicontinuum of measurements over the surfaces 20A, 20B. In another embodiment, carrier 32 may be configured for discontinuous movement of substrate 10, stopping at each of a plurality of predetermined measurement locations. Preferably, the carrier 32 is configured for movement of substrate 10 to permit measurements to (or very near to) the edges 22A, 22B, and/or edges 18A, 18B, so that maximum warpage displacement may be determined.

Please amend paragraph **[0039]** as follows:

[0039] Turning now to FIGS. 10 and 11, a currently preferred embodiment of a measurement yoke assembly 48 of a thickness/warpage measurement apparatus 30 of the invention is depicted. Yoke assembly 48 has first yoke member 42A and second yoke member 42B. Both yoke members 42A, 42B are mounted on bases comprising base members 44A, 44B, ~~resepectively.~~ respectively. The base members 44A, 44B are shown as being rigidly joined by crossbar 82. Each yoke member 42A, 42B has a clamp end 84A, 84B, respectively, into which is clamped a linear measuring device 50A, 50B, respectively. A biased finger, i.e., shaft 60A, 60B, projects from each of the linear measuring devices 50A, 50B, respectively, and these fingers 60A, 60B are coaxial about axis 38. Linear measuring devices 50A, 50B may take various forms, e.g., linear encoders, and are readily available commercially. For example, ~~on suitable~~ one suitable measuring device is a Sony Gauge Probe, Model DG10BN. A contact member 52A, 52B is mounted on the exposed end of each finger 60A, 60B for contact with the substrate surfaces 20A, 20B, which typically are generally mirror images of each other. As shown in FIGS. 10 and 11, substrate 10 includes an exemplary semiconductor device (unnumbered) mounted thereon. In the illustrated embodiment, the contact members 52A, 52B comprise rollers 76A, 76B formed of carbide or other hard material, but as already described, other types of contact members may be used. As shown, each linear measuring device 50A, 50B has electrical leads 80 extending therefrom for communication with computer 70, memory 68 and output device 74 (FIG. 5). In FIG. 10, the rollers 76A, 76B are shown as contacting each other, i.e. at a calibration zero point 66 (see FIG. 9). The finger extension distance or position for each finger 60A, 60B at calibration zero point 66 is recorded for each contact member 52A, 52B, respectively. A substrate 10, shown as an exemplary semiconductor memory module, is shown positioned (by a carrier, not shown) ready for measurement in FIG. 10. When measurement of substrate 10 is to be undertaken, substrate 10 is passed in plane 62 between the two coaxial contact members 52A, 52B, as shown in FIG. 11. Plane 62 is generally perpendicular to axis 38 of the fingers 60A, 60B. When a desired measurement location on opposed substrate surfaces 20A, 20B is reached during travel of

substrate 10 between the two contact members 52A, 52B, the respective linear positions of fingers 60A, 60B are recorded.

Please amend paragraph **[0041]** as follows:

[0041]

Location	Reading –	Zero pt 66 =	Displacement Distance	
56A (edge)	2.1344	2.0714	0.0633	(surface 20A)
	2.3200	2.2573	0.0627	(surface 20B)

Thickness 16 at location 56A = 0.0633 + 0.0627 = 0.1250

56B (center)	2.1381	2.0714	0.0667	(surface 20A)
	2.3156	2.2573	0.0583	~~(Surface~~ (surface 20B)

Thickness 16 at location 56B = 0.0667 + 0.0583 = 0.1250

56C (edge)	2.1338	2.0714	0.0632	(surface 20A)
	2.3190	2.2573	0.0617	(surface 20B)

Thickness 16 at location 56C is 0.0632 + 0.0617 = 0.1249

Please amend paragraph **[0045]** as follows:

[0045] A variation of the apparatus 30 of FIGS. 10 and 11 is depicted in FIG. 12. In this variation, a plurality of caliper gauges 40, each with opposing contact members 52A, 52B, is mounted to a yoke assembly 48 to simultaneously determine thickness 16 at locations 56 along a plurality of paths, generally three. In this example, measurements are made at each of points 56A, 56B, 56C, 56D, 56E, 56F, 56G, 56H, and 56J along three paths 28A, 28B, 28C across a surface 20A of a substrate 10 (see FIG. 14). The opposite surface 20B will generally be characterized as a mirror image of surface 20A. As a result, warpage displacement and substrate thickness 16 may be determined in three longitudinal paths 28A, 28B and 28C, and the same determinations made along three cross-directions 29A, 29B, and 29C. Thus, the determinations are completed in a single pass, and warpage, including any complex warpage, may be readily characterized in two directions. It should be noted that linear measuring devices ~~50A through~~

50A, 50B, 50C, 50D, 50E, 50F may be adjusted upwardly and downwardly with respect to the path of a substrate 10 to accommodate wider or narrower substrates and for placement to avoid components such as semiconductor devices mounted on a given substrate 10.

Please amend paragraph **[0048]** as follows:

[0048] In another embodiment as depicted in FIG. 15, measurements may be taken in a once-through continuous manner over the surfaces 20A, 20B, enabling a complete warpage/thickness analysis along every point in three parallel paths 28D, 28E, and 28F. ~~Cross-direction~~ Cross-direction warpage may be computed continuously along any portion of the paths, or may be restricted to particular desirable cross-path(s) 29X comprising measurement points 56K, 56L and 56M on the surfaces 20A, 20B, including, if desired, cross-paths 29D, 29E and 29F. If desired, a virtual representation of the substrate planarity, or lack thereof, may be generated and displayed against a baseline representing an ideal substrate, or at least one within specified planarity tolerances.

Please amend paragraph **[0049]** as follows:

[0049] As already shown, the apparatus and method of the invention offers many advantages. First, accurate measurements of substrate thickness and warpage in more than one direction may be performed. The apparatus may be placed as part of an assembly line using automated substrate handling equipment. Zero calibration of the linear measuring devices 50 is simple, i.e., merely bringing the corresponding contact members 52 together and recording the distance or position measurements of fingers 60 within the two linear measuring devices 50. These measurements comprise the calibration zero points 66 for each linear measurement device. The apparatus of the invention may be formed from commercially available linear measuring devices 50, computer 70, memory 68 and output devices 74, such as a computer screen, printer, video, etc.